the Mechelecia

VOL. 12 NOVEMBER 1952 NO. 2

THE SCHOOL OF ENGINEERING
GEORGE WASHINGTON UNIVERSITY

To keep steel strip on the straight and narrow

. . . at 1000 feet per minute!

● Threading its way through a gigantic continuous-annealing furnace at speeds up to 1000 feet per minute, steel strip behaves erratically. It tends to wander and weave. It fouls the rolls. Sometimes it breaks. Then production on a multi-million-dollar unit, designed for high-speed operation, slows down or stops dead . . . a very costly business.

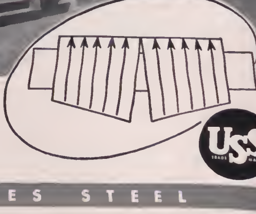
To solve this problem—to keep strip from running crooked—all sorts of schemes have been tried; crowned rolls, higher tension on the strip, side guides. None of them worked as hoped for. Each merely added new problems of its own. To make matters worse, with recent trends to longer strip, to higher speeds and longer processing lines, these tracking and aligning difficulties were further aggravated.

But the answer has been found. In the development of the Lorig Aligner, United States Steel has come up with a novel, yet surprisingly simple solution. For these rolls, named for the inventor—a U. S. Steel engineer—are *automatically* self centering. Set in the continuous-annealing line shown here, they now track the strip—no matter what its speed—relentlessly toward the center of the roll. These remarkable rolls even *anticipate* trouble and realign wayward strip 30 feet *before* it reaches the roll.

The result? Clean, bright strip, flat and undamaged, uniformly and perfectly annealed, reeling off the delivery end at the rate of 1000 feet per minute.

The U·S·S Lorig Aligner—a brilliant application of basic engineering principles—is full of promise not only for continuous strip lines of all kinds, but wherever production depends on accurate tracking of the material. In other words, if centering and alignment is the problem, the Lorig Roll is literally the key to continuous high-speed production.

The Lorig Aligner is another example of United States Steel's active research program which has enabled countless manufacturers to improve their production methods and make better products in the bargain. In the field and in research laboratories, trained U. S. Steel engineers and metallurgists are working to help make the manufacture of steel—and its use—more efficient. United States Steel Company, 525 William Penn Place, Pittsburgh 30, Pa.



THE U·S·S LORIG ALIGNER consists of a divided roll (conical effect exaggerated at the right) with each conical half running on a common rotating axle that is slightly deflected in the center so that the upper surfaces of the cones form a straight surface. As the strip passes over the roll, strongly converging lateral forces are set up to exert a powerful centering action on the strip that immediately corrects any deviation and keeps the strip running straight and true.

USS

UNITED STATES STEEL

The Mecheleciv

VOL. 12 NOVEMBER 1952 NO. 2

ON THE COVER . . .

A proposed single-cable suspension bridge to be built in Stockholm, Sweden. This is one of several single-structural-member bridges being built in Europe. Several bridges utilizing a single center truss have been built in Germany.
Courtesy Engineering News Record.

FRONTISPIECE . . .

"Point of no return." This is the name that Westinghouse has given to its new Sound Lab in the suburbs of Pittsburgh, Pa., where the surrounding noise level is quite low. The inside of the building which is constructed of twelve inch walls contains the room in the picture. This 19 x 13 x 10-foot room is completely covered with insulating material shaped in the form of wedges. These wedges are the very heart of this anechoic chamber. The same conditions exist in this room that one would find at an altitude of 50 or 100 miles. Sound waves emanate from the source in all directions and disappear since there can be no reflection in this near perfectly insulated room.
Courtesy Westinghouse

ENGINEERING SCHOOL CALENDER

November 19—Sigma Tau—Monroe Hall, 8:15 P.M.

November 26—Theta Tau—Conference Room, Student Union Annex, 8:15 P.M.
Engineers Council—Building N, 8:30 P.M.

December 3—Engineering Societies — Monroe Hall, 8:15 P.M. Cherry Tree Pictures, Refreshments at Engineers Club.

December 3-5—Am. Soc. Mech. Eng'rs. Conference, New York City.

December 10—Theta Tau—Confernce Room, Student Union Annex, 8:15 P.M.

December 13—Sigma Tau—Initiation, Lisner Auditorium, A & B Banquet, Continental Hotel, 7:00 P.M.

December 15—Christmas Tree Lighting—Lisner Terrace, 5 P.M.

December 17—Engineers Council—Building N, 8:30 P.M.

IN THIS ISSUE

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Grand Opening . . .

The annual Engineer's Open House was held last week in the recently completed engineers club. Guests included hundreds of engineering alumni and high school students from the Washington area. After an opening address by the Dean, the facilities of the Engineering School were inspected by the gathering. The highlight of the evening was a tour of the clubhouse which was replastered, completely repainted and furnished by the engineering students, alumni and friends. Offices for the undergraduate engineering societies; the two fraternities, Theta Tau and Sigma Tau and the Engineer's Council as well as the headquarters for the three alumni organizations, the Engineering Alumni Association, the National Capital Alumni Association of Theta Tau and the Sigma Tau Alumni Association are located on the second floor. The alums, by having their headquarters here at the university, expect to maintain much closer contact with the school and in this way support its activities and help further its growth.

The first floor contains a lounge with a cheery fireplace and an adequate supply of periodicals and newspapers both of a technical and a general nature, and a study room containing the nucleus of an engineering library. Students and alumni have made contributions of well known magazines and others have donated reference or text books to this library which may grow to rival the law library here at school.

The basement contains a kitchen and a recreation room. Many of the social affairs which in the past have been held off-campus will be held in this part of the house; all of the engineering societies and fraternities plan to hold their formal social functions at the club and it is expected that the three alumni organizations will take advantage of this facility for their social functions. Refreshments for the open house were served from the kitchen.

All persons attending this first open house in the engineer's own club were well pleased. Those who cooperated to make this possible are to be congratulated. If the cooperation continues, the house as well as the Engineering School will continue to benefit from the effect it has on the students morale.

This article could appear in a future issue of this magazine. Will you see that it does?

JET AUTOMOBILES

Today, Tomorrow, or Never?

Edward R. Caldwell, BCE '53

The gas turbine powered automobile and truck is today a reality. Since the middle of 1950 both the GT automobile and truck have been on the road. Whether they will ever become the successors of the internal combustion piston-engined automobile and truck will now be considered.

The first GT automobile was built and operated by the Rover Motor Car Co. of England. This car is powered by a 200 bhp gas turbine engine burning kerosene. The engine is located behind the single seat. An electric starter is used to start the engine and the only other controls are an accelerator and a brake. This Rover car reached operating temperature in 16.6 seconds on a very cold day and attained a speed of 60 mph from a standstill in 14 seconds. The top speed is estimated to be 93 mph.

The first GT powered truck was built by the Boeing Airplane Co. of this country in cooperation with the Navy Bureau of Ships. The truck is powered by a 175 bhp "502" engine. The semi-trailer into which this engine was installed weighed 68,000 lbs. Even under this load the "502" transmission contained only one-half the gears of the previous transmission. The truck manuevered at a crawl, traveled at 50 mph with a full load, and took steep grades at speed without changing gears. The fuel consumption was two miles per gallon. It is estimated that a five speed gearbox may be necessary in mountain operation of a 70,000 lb. load. The "502" engine occupied only 13% of the space formerly occupied by the diesel engine and could, therefore, be adapted to almost any automobile.

Gas Turbine Described

"The gas turbine one day is going to replace the piston engine, in most applications from 50 horsepower to 500, as surely as the piston replaced the original four-footed horsepower itself." So says Ed Wells, head of the Boeing Airplane Co. Engineering Dept. and design supervisor for the Boeing "502" gas turbine engine.

If this be so then it is necessary that we know what a gas turbine is and how it is applied to highway transportation. A very elementary gas turbine cycle is shown in Fig. 1. The "502" cycle is as follows: air is drawn in through the centrifugal blower, having a maximum continuous speed of 36,000 rpm, and compressed to 43 psi while the temperature is raised to 270°F.; liquid fuel, at 400 psi, is injected into the air stream and the mixture is burned, raising the temperature to 1500°F.; the mixture expands through the first turbine which drives the centrifugal compressor at the beginning of the cycle; the gas is then fed to the second turbine which drives the output shaft and the gas is exhausted to the atmosphere at about 1150°F.

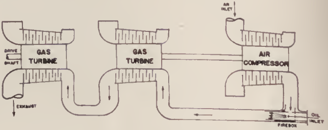

Fig. 1

Schematic Gas Turbine Cycle

There is no mechanical connection between the two turbines. The compressor turbine rotates at 36,000 rpm while the output turbine rotates at 24,500 rpm.

The GT engine develops enormous low speed torque with the maximum occuring when the compressor turbine is at full load and the output turbine is stalled (see Fig. 2). In comparison, the Chrysler 180 bhp V-8 engine develops 312 ft.-lbs. of torque at 2000 rpm whereas the 175 bhp Boeing "502" engine develops 585 ft.-lbs. of torque at standstill.

Other things being equal, the fuel consumed in delivering a certain hp for a given length of time (lbs./hp-hr.) depends on how high the temperature of the working fluid can be raised before expansion begins. At the present time the temperature cannot go much above 1500°F. before centrifugal force fractures the turbine blades or causes them to creep out of balance. Due to this shortcoming the compressor must pump a large quantity of air for cooling the turbine blades only.

The specifications of the Boeing "502" engine are as follows:

Length	38.5″
Diameter	22.2″
Frontal Area	2.2 sq. ft.
Weight	202 lb.
Oil Consumption	0.25 lb./hr.
Air Mass Flow	3.25 lb./sec. max.
Power Output (max.)	175 hp @ 2700 rpm
Torque (max.)	585 lb.-ft. at stall
Fuel Consumption (min.)	1.25 lb./hp-hr.

Comparison With IC Engines

Advantages:

1. Good performance with a simple gearbox (probably only a reverse gear) which does not require a clutch. A turbine is comparable to a piston engine with a torque converter.
2. Much smaller number of parts—about ⅓. Overhaul costs would be lower.
3. ½ to ⅔ less space occupied. The engine may be either in the front or the rear of the car. If the engine is located in front of the driver a drive shaft to the rear axle is required. If the engine is located behind the driver air intake ducts are required.
4. ⅔ lighter in weight.
5. Much less vibration since power is produced continuously.
6. Operates at a higher continuous temperature.
7. Cannot freeze in winter since there is no water.
8. Operates on cheap fuels (kerosene, diesel oil, gasoline, or powdered coal) without knocking.
9. Simpler lubrication and electrical systems.
10. Development time reduced to ¼ that of piston engine since new GT engines are only larger or smaller than their predecessors.

Disadvantages:

1. High fuel consumption—twice that of gasoline engine, three times that of diesel engine. (see Fig. 2). Oil consumption is one quart in every 1000 miles.
2. Inadequacy of present metals to withstand expansion at higher temperatures. Piping and ducting would require expansion joints.
3. Complicated governing devices for inexperienced drivers.
4. Exhaust ducting with ten times the area of IC engines would be required.
5. Power output falls in hot weather.
6. Reduction gearing to reduce speed of rear axle.
7. No engine braking—may be solved with reversing gear.
8. Muffling of high gas flow.
9. Less mileage between repairs.

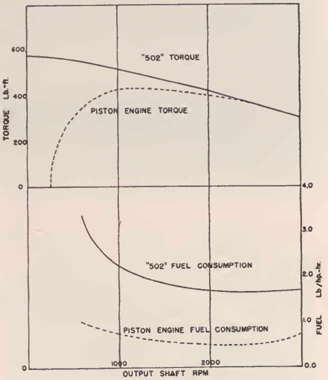

Fig. 2

Performance Data

Conclusions

Any new form of power plant, if it is to succeed the internal combustion engine, must be (1) cheaper to produce, (2) cheaper to operate, or (3) smoother, quieter, and easier to drive.

Production costs at present are very high although Boeing engineers predict that with production as low as 1000 units a year the "502" engine can compete at initial cost with the internal combustion piston engine. The higher speeds and higher component efficiencies existing in the turbine require higher quality; for example, each turbine wheel has from 80 to 150 blades, each of which costs about the same as a present exhaust valve.

Present automobile size turbines consume twice as much fuel at full load as the typical IC engine and at 30% load the GT consumes four times as much fuel. While kerosene at present is much cheaper than high grade anti-knock gasoline, it may not remain cheap if the demand greatly increases.

The GT powered automobile is undoubtedly

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The Train of the Day After Tomorrow

Alfred B. Moe, BCE '53

Railroads have long been the symbol of transportation and progress in the United States as well as in the rest of the civilized world. Railroads have set the pace in many engineering developments and have provided, for many years, the major testing facilities for the products of engineering. Up to within a few years, the railroads have been content to improve safety, speed and comfort and have succeeded, at least in the United States, in producing the finest, fastest and most luxurious trains in the world.

It seems rather odd, however, that in the prolific history of railroading that many of the inventions relative to railroading were not those of Americans. The steam engine was born in Great Britain, the diesel in Germany and, last but not least, one of the most interesting innovations in railroad history was created in Spain, a country not generally recognized as one producing engineering marvels.

A few years ago, a Spanish Army Engineer named Lt. Col. Alejandro Goicoechea Omar decided that railroad equipment must be made simpler and lighter. He, like many others, became impatient with the complicated mechanics and heavy dead weight of standard equipment. He could see an economic future to railroads only if something radical was achieved to stop the trend toward more weight and greater complexity. The importance of this thinking cannot be overlooked.

In this country even though we have developed trains with superb riding qualities, safety devices that result in millions of miles of fast, accident-free operations, and powerful locomotives, the speed of trains has not increased to a great extent in the last 20 years and has, in many instances, actually decreased. The reason for this seemingly poor performance, which does not take advantage of high-quality rails, excellent track, workmanship, and the skill that has been developed in the production of our luxury liners of the rails, is that comfort speeds generally fall far below safety speeds.

Present trains are heavy and have a high center of gravity. The terrain in the heaviest populated areas in the United States are the areas that support the greatest amount of traffic but do not offer the long stretches of smooth track required for fast operation. Much of our eastern trackage has countless curves and heavy grades. Many of these curves are so sharp that trains must proceed around them at greatly reduced speeds. To reduce or eliminate these curves in the east or west may mean the moving of mountains or rivers, or, in crowded cities, buildings and factories. This is expensive and few railroads could afford such a project just to save a few minutes elapsed time. The great weight of the standard train precludes rapid acceleration or deceleration and, therefore, a great deal of time is lost between scheduled stops.

The Spanish train or Talgo is a definite improvement in the design of modern trains. Not only has the weight been reduced to that of a

fraction of standard equipment, but safety has been improved and its performance in actual service has been almost unbelievable. What is so radical about this new machine that has attracted the attention of the traveling and engineering world? Since the revisions are many, they will be described in an orderly manner and in sufficient detail to permit the reader to fully appreciate the importance of this great discovery.

Talgo is not merely a name, it is logically derived from the description of the train and the initials of its inventor and backer, Tren, Articulado, Ligero, Goicoechea and Oriol, which means that it is an articulated or jointed, light, train, invented by Goicoechea and financially backed by the Oriols, a famous industrial family of Spain.

Observation Unit

Probably the most outstanding element of this train is the Talgo coach. Each coach is designed as a series of five articulated units, supported on a pair of trailer wheels, each car being supported on the back of the car before it. This novel arrangement of supporting the coach or coaches, if one desires to think of a five unit assembly as being more than one coach, results in greater safety at high speeds as well as a greater riding comfort since each unit is a trailer which is guided in the direction of its travel; and the parasitic motions created by standard trucks are eliminated.

When standard trucks go around a curve, the forward wheels of the truck have a tendency to climb over the rails since the flange on the forward part of that wheel is rubbing against the rail in a downward motion. The reaction created by this motion tends to lift the wheel as well as retard the rotary motion of the wheel. The wheels on the Talgo unit are guided so that the forward flange of the wheel is pulled away from the rail resulting in a negative angle of attack. The rear portion of the flange tends to hold the wheel down by its reaction with the rail thereby adding to the safety of the train. This condition does not exist as far as the locomotive is concerned; there is nothing ahead of it to provide the guiding action necessary to fully utilize the advantages of the train. The locomotive does, however, owe its ability to take the curves at higher speeds to its low center of gravity.

Not only is the designer content with his novel wheel arrangement but he has suspended his running gear in the most unusual manner. The wheels are attached to a "U" shaped non-rotating drop-axle and the whole wheel and axle assembly is suspended from the sides of the car approximately 40-inches from the top of the rail. This

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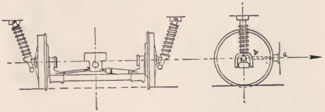
Rear end of unit showing wheel suspension



Car Wheel Arrangement

Powder Metallurgy

Harold Loomis Boyd, BME '53

A field of manufacturing which has grown rapidly during the past few years is that of producing metallic articles by pressing powdered metal into dies. The most widely used materials for this process of manufacturing are iron and copper base metal powders, both of which are produced in a wide variety of alloys. There are various ways of producing metal powders. For example, brittle metals can be crushed into a very fine powder or by a thin stream of molten metal poured through a blast of compressed air or steam. The metal is atomized by the air or steam and it solidifies to form a fine powder. Some molten metals, if rapidly stirred in an oxidizing atmosphere, will form oxides on the surface of the molten droplets. If stirring is continued, the mass will become granular as it solidifies. The powder is then heated below its melting point in a reducing atmosphere to reduce the oxides. This method is used commercially in the production of tungsten, iron, molybdenum, nickel and cobalt powders.

Once the metal powders are produced, they can be mixed with powders of other metals to form various alloys, or be pressed into shape just as they are. A lubricant is usually added to the powder to reduce die wall-friction and to aid in ejection from the die. Some typical lubricants used are lithium stearate, stearic acid, and powdered graphite.

The powders are then pressed into shape in steel dies under pressures which range from a few thousand to about 200,000 pounds per square inch. Soft powders squeeze together to the proper density and do not require the high pressures that are needed for hard powders. The density and hardness increase with the pressure, but in every case there is a limiting pressure, above which these properties do improve very little.

After an article is pressed into shape it will hold together, but its strength-and-hardness values are relatively low. The metallic particles can be bonded together better if the article is heated to an elevated temperature. This process is called "sintering." The "sintering" temperature varies over a wide range depending on the metal used and the properties desired, but it is always below the melting point of the main powder constituent.

After the "sintering" operation, the article may be coined or sized to increase the strength and density or to give better dimensional accuracy. Other operations such as heat-treating or electroplating can also be performed on the article. For best results, however, the density of the article must be fairly high.

Most items produced from metal powders are porous to some extent. The exact porosity depends upon compacting pressure, "sintering" time and temperature, and on subsequent coining or repressing operations. Tensile properties of articles produced by powder metallurgy are good. For an alloy of 70 percent copper and 30 percent zinc, for instance, a tensile strength of about 36,000 p.s.i. can be obtained. Iron parts made by this process can be hardened by standard methods, and Rockwell C values of 60-65 have been consistently obtained.

Courtesy Mechanical Engineering

Except for pins, springs, and shackle, major components of this padlock are made of brass powder

The manufacture of articles out of metal powders has several definite advantages over other manufacturing processes. For example, this is the only process by which porous bearings and certain kinds of alloys can be produced. Due to the close tolerances and good surface finishes that can be obtained on small parts made by this process, it can compete with production of machined parts in large-scale production. This process is also quite economical in the use of material, since there are no losses in the pressing operation and tolerances are so close that no allowance need be made for machining. Another advantage of this

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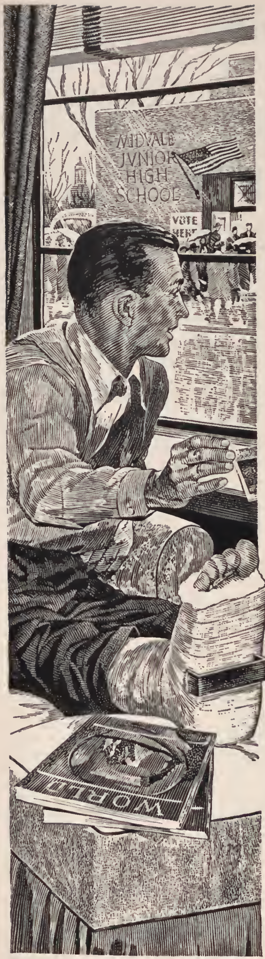
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VOTE
HERE

RCA FELLOWSHIPS

THE RADIO CORPORATION of America has expanded its post-graduate fellowship program, Dr. C. B. Jolliffe, vice president and Technical Director of RCA, has announced. Fourteen fellowships were offered for the year 1952-1953. This represents an increase of one Fellowship since last year. The amount of the annual stipends has also been increased.

These Fellowships provide assistance for promising students who wish to do graduate study and research in electronics and related fields. Applicants must be citizens of the United States and full time graduate students registered in an approved university. They must be recommended by appropriate University officials. The appointments are made for one academic year but they may be renewed.

Grants from the National Research Council make it possible for RCA to administer additional Fellowships. The RCA Fellows under the NRC are expected to work on scientific problems related to electronics, but applicants who wish to supplement mastery in this field by developing competence in another field are considered.

There are RCA Fellowships in six universities. Among them is the David Sarnoff Fellowship, established at New York University in 1951 to honor the Chairman of the Board of RCA. There are other RCA Fellowships at the following universities: California Institute of Technology (Electrical Engineering) Pasadena, Calif.; Columbia University (Physics) New York, N. Y.; Cornell University (Engineering Physics) Ithaca, N. Y.; New York University (Electrical Engineering) New York, N. Y.; Princeton University (Electrical Engineering) Princeton, N. J.; and the University of Illinois (Electrical Engineering) Urbana, Ill. An annual grant of $2,700 is made to each of these universities to be used by the university in providing a stipend for the Fellow and for University fees and apparatus.

Requests for application blanks and additional information concerning RCA Fellowships administered by the National Research Council should be addressed to: Fellowship Office, National Research Council, 2101 Constitution Avenue, Washington 25, D. C. Applications for the RCA Fellowships should be made to the universities as selection of the RCA Fellows is the joint responsibility of the university officers and the RCA Educational Committee. This committee is made up of nine officers of the corporation.

$6750 ENGINEERING UNDERGRADUATE AWARD PROGRAM

The Rules and Conditions for the sixth annual competition of the Engineering Undergradate Award Program have been released by the James F. Lincoln Arc Welding Foundation. The Rules for this year's competition have been changed in a number of important respects:

1. The 46 awards to be made will be for the best designs of a machine, machine component, structure or structural part that has been designed for welded construction.
2. Duplicate awards will be made for the best entries in both mechanical design and structural design. Additionally, three grand awards will be made to the best of the Program designs.
3. To permit participation in the Program within the restriction of the time available in the normal curriculum, all entries will be limited to no more than 20 pages. Undergraduates will also be permitted to complete their entry for the Program after graduation.

The Rules and Conditions booklet, now available from the James F. Lincoln Arc Welding Foundation, Cleveland 17, Ohio, gives suggestions for subject matter, a bibliography, and previous award titles illustrated with drawings. Booklets can be examined in the Dean's Office, School of Engineering or on the Bulletin Board outside the Engineers Lounge.

U. S. MUST BOOST PRODUCTIVITY 45 PERCENT IN NEXT 10 YEARS

"Industrial productivity must increase 45 percent within the next ten years if the United States is to maintain a balanced, expanding economy!" This was the keynote of a talk presented at the recent Centennial of Engineering in Chicago, Ill., by Frank R. Benedict, industrial products engineering executive of the Westinghouse Electric Corporation.

Speaking before the American Institute of Electrical Engineers, Mr. Benedict added that this increased productivity could be achieved only by more intensive application of new technological developments throughout industry. The need for this increase, he maintained, is brought about by the "insistent demand for a constantly improving standard of living by a steadily increasing population. Great strides in the treatment of sickness and disease has decreased the death rate, and this, coupled with the high birth rate, has produced a much steeper population growth than has been experienced in the past."

In the face of a serious shortage of scientists, development, and design engineers, industry must meet this challenge for increased productivity with every facility at its command. A major problem in applying new technological development is that of completely coordinating development of products with development of tools to manufacture them. Without such coordination, economical manufacture may not be possible. For many new products, it may be advisable to build full-scale pilot plants to "prove the design for manufacture."

There's something
here somewhere
about laying
an egg...

ONCE UPON A TIME there were two farmers. Each had a hen that laid 20 eggs a month.

Both farmers liked eggs, so one ate his. But the other did without, and put his eggs in an incubator which he bought by borrowing money. In no time he had 200 chickens from his one. A shocking profit! (Before taxes.)

He sold some to pay down the loan on his incubator; he ate some as a reward for all his labor in raising the brood. And he sold a good many to pay his income tax.

He still had some left. Profit.

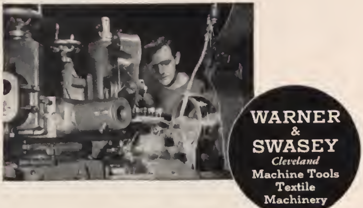
So the farmer who had eaten all his eggs got a law passed. The neighbors divided up the chicken-raising-farmer's "profits" and ate them. After all, they said, he had more than he needed, and they were hungry.

So, of course, the farmer wasn't going to raise any more chickens just to have them taken away from him; he ate his eggs, too.

In due time both the farmers' original hens died of old age, and then there weren't any eggs for anybody. No chickens either.

The neighbors were quite sure it was somehow the chicken raiser's fault.

Did the farmer, who used to eat all his eggs, enjoy his now-eggless meals any more for realizing that the farmer next door wasn't enjoying any chicken?



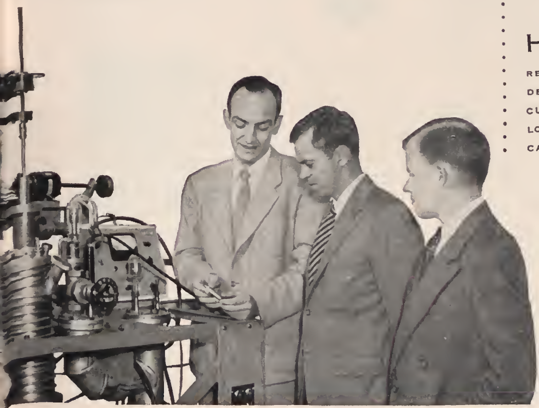
YOU CAN MACHINE IT BETTER, FASTER, FOR LESS WITH WARNER & SWASEY TURRET LATHES, AUTOMATICS, AND TAPPING MACHINES

Hughes Fellowship 1952 winners Truman O. Woodruff (left) and Allen I. Ormsbee (right) are welcomed to the campus by Dr. Lee A. DuBridge, President, California Institute of Technology.

THE HOWARD HUGHES FELLOWSHI

in science and engineering

Semiconductor research is one of the important projects of the Laboratories. A development of immediate value is the Hughes Germanium Diode employed in miniaturized airborne electronic equipment. The apparatus shown in the photograph is a vacuum furnace constructed to produce single crystals of germanium. Discussing its operation are (left to right): Hughes Fellow Allen I. Ormsbee; Dr. H. Q. North, Head of Semiconductor Department; Dr. Allen E. Puckett, Head of Missile Aerodynamics Section; and Hughes Fellow Truman O. Woodruff.



SOCIETIES AND FRATERNITIES

● The November meeting of the I. R. E. Branch at the University was highlighted by Dr. Homer E. Newell of the Naval Research Laboratory on "Upper Atmospheric Research with Rockets." A technicolor film of the launching of the rocket-powered, high altitude projectile, "Viking", capped Dr. Newell's talk.

Dr. Newell outlined the type of problems that are susceptible to the type of attack possessed by high altitude rockets carrying specialized instrumentation and information transmission, between missile and the ground, by radio-waves.

Upper air research has been of interest for a long time. The early investigators used kites; their successors employed balloons and those in recent times used radio-pulse techniques and since the war the use of rockets. The last method has pushed the limits of certain problems to 200 miles out.

It is requested that all I. R. E. members and other interested students attend the December meeting of the I. R. E. on December third at 8:15 P. M. in Room C-3 when the speaker will be Mr. William W. Balwanz who will talk on radio receivers.

Pictures will be taken for the 1953 Cherry Tree at this meeting.

● On Wednesday, November 5, the Student Chapter of the American Society of Civil Engineers of the George Washington University held its first meeting of the 1952 scholastic year. Mr. Waldo E. Smith, who is President of the District of Columbia Chapter of the American Society of Civil Engineers spoke on "The Viewpoint of the Engineer." Mr. Smith is also a member of the American Geophysical Union and of the National Research Council.

And so, being one who knows, Mr. Smith went on to say that the Engineer of today is no longer a "hired man." He must take an active part in the affairs of his community; he must assume more responsibility in state and national matters. He no longer works on isolated projects; the rest of the world is curious and interested as to the latest developments on the reclamation of arid lands, the building of dams and bridges as well as other phases of engineering. He cited Herbert Hoover as an example of a successful engineer and international figure; he also made reference to a Senator from Vermont who is an engineer and a distinguished politician.

Mr. Smith gave the students a few helpful pointers on how to study. One must not be satisfied with what the textbook of a particular course has to offer; one must be interested enough to do additional research on his own; one should participate in the University's athletic programs and other extra-curricular activities (women, as an activity, being excluded!) The engineering student should develop qualities of leadership. ENGINEERS MUST BE LEADERS.

A very interesting one-day conference is being planned for sometime in January. The first prestressed concrete building in the Washington Area is now under construction in nearby Arlington County. The building, a church, will have a prestressed concrete floor with a clear span of 45 feet, 6 inches and a depth of 17 inches. This conference will be sponsored by the G.W.U. Student Chapter of the A.S.C.E. for the benefit of engineers, architects, contractors and all others in the Greater Washington Area interested in building construction.

The conference will consist of a series of papers on various phases of prestressing. The highlight of the day will be a public load test of one of the prestressed beams at the church mentioned above.

It was announced that the G.W.U. Student Chapter received honorable mention from National Headquarters on its last annual report.

● At the Nov. 5, 1952 meeting of the G.W.U. student branch of the A.S.M.E., Mr. S. D. Fulton, who heads the Turbine Division of the Westinghouse Electric Corp., delivered a very interesting talk on "The Development of the Steam Turbine."

The G.W.U. Chapter joined with its brother chapters from Maryland University and Catholic University Thursday Nov. 6th for a tour of the Naval Ordnance Lab at White Oaks, Md. The tour was extremely interesting and was thoroughly enjoyed by all.

A student member, senior member smoker was held at Coral Hall Tuesday, Nov. 18th. Entertainment was by Miss Sandra Phillips, a very lovely vocalist and Miss Kay Howard who showed us a very excellent hula.

● On Nov. 1, 1952, District 2 of the A.I.E.E. held a convention at Toledo, Ohio. The G.W.U. Student Chapter was represented by Waldo German, Chairman and Homer Musselman, Vice Chairman, along with counselor Prof. Norman Bruce Ames, head of the School of Electrical Engineering.

The first meeting of the G.W.U. Student Branch of the A.I.E.E. was held Nov. 5th. The speaker was Mr. Max Tall, Production Engineer of the Vitro Corporation of America, who spoke on "The Reliability of Electronic Circuit Components." Mr. Tall emphasized the point that present day electronic circuit design problems require the services of mechanical engineers and experts in the field of thermodynamics as well as electronic and electrical engineers.

A motion picture, "Shining Rails" and a lecture on electric traction are tentatively scheduled for the Dec. 3rd meeting.

● Theta Tau, at a special meeting November 26 elected Dan Andrich Delegate to the Nineteenth Bi-ennial Theta Tau Convention to be held at Purdue University December 29, 30 and 31. Waldo German was elected Alternate Delegate. Dan is bucking tradition on this trip since the last two Delegates from G. W. came away with the highest honors, that of being selected the Outstanding Delegates of the convention. At the same time, Honorary Members were nominated. Their names will be published when they are elected.

ENGINEERING PERSONALITIES

HARRY KRIEMELMEYER, JR.

Floats, bleachers, and parades are a specialty of Harry "Crinkle-fender" Kriemelmeyer, who kept the procession moving as Homecoming Parade Chairman in 1952.

Harry, a Mechanical Engineering major at the University, will graduate in June with 144 credits. Besides directing the Homecoming Parade, his budding engineering skill has been evidenced in many ways. He was coordinator of the Halloween dance which honored the Engineering School, and is the 1952 President of the Engineer's Council, which has executive control of the Engineering School.

Harry has been active on Mecheleciv, the engineering magazine since 1950 and is presently Secretary of Sigma Chi. The positions he has held for Sigma Chi have run the gamut from pledge trainer to Vice-President. Harry was elected to Sigma Tau, the engineers' scholastic honorary society, in 1951, and is Treasurer of the American Society of Mechanical Engineers.

Besides finding time for extra-curricular activities, Harry has kept himself busy during summers getting actual experience in engineering. In 1952, he worked as engineering aide at David Taylor Model Basin (U.S.N.) in the structural mechanics laboratory testing and analyzing ship structures under simulated actual load and overload conditions.

In 1951 he worked at Engineering Research Corporation (ERCO) as a mechanical draftsman on electronic flight simulators.

Even as a kid, Harry had a hobby of building model airplanes and ships. In Coolidge High School, he enjoyed working with automotive equipment, mathematics and physics, which helped him to decide on a career in Mechanical Engineering.

When he graduates, Harry hopes to enter the United States Air Force as a commissioned mechanical engineer. Meanwhile, he distinguishes himself on the G. W. campus by being the first person to park in the new University parking lot.

BIOGRAPHY OF NORMAN B. AMES

I was born July 1, 1896 at Richmond, Virginia. Two years later my family moved to Long Island for two years, returning to Westmoreland County, Virginia, on the Potomac in 1900. Upon the death of my mother in 1907 I went to Mississippi. Here I attended public school and Mississippi State College, graduating with a BS in EE degree in June 1915.

In July, 1915 I took a job as "copyist electrical draftsman" in the old Radio Test Shop which was the beginning of all of the Navy's present radio research and development activities. I started at the Test Shop in July 1915 and registered at GWU in September. By the end of the summer of 1916 I had completed the requirements for BS in EE degree and in September I pulled out for Boston and MIT.

By June 1917 I had completed requirements for their undergraduate degree and some graduate work. I received a bachelor's degree from Harvard University at the same time as both schools had combined their engineering courses. This arrangement lasted only four years. Before leaving MIT I was offered a job as Apprentice Signal Engineer with the Pennsylvania R.R. but I did not take it because of the war.

In November, 1917, I was ordered to Ft. Leavenworth, Kansas, as an officer candidate in the Infantry but was discharged for physical disability in January, 1918. Before discharge, however, I took the flying cadet examination of the Signal Corps and failed the eye test but was commissioned a 2nd lieutenant, Aviation Section, Signal Corps, February 13, 1918. Six weeks at the Signal Corps Radio School, College Park, and I was on my way overseas as a Squadron Radio and Electrical officer. After a tour of inspection duty in Paris during the summer I was ordered to the 258th Aero Squadron, served with them in France and Germany and came home with them in August 1919. I was discharged at Camp Lee, Virginia, that same month.

My job with the Pennsylvania was still waiting and in September I began swinging a pick and

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JET AUTOMOBILES *(Continued from page 9)*

smoother and quieter operating. Whether it will be easier to operate remains to be seen.

New developments in the gas turbine are limited to: (1) Higher compression ratio; (2) Higher component efficiencies; (3) Exhaust heat recovery; (4) Variable nozzle turbines; (5) Higher gas temperature.

Higher compression ratio and higher component efficiencies mean more turbine stages and, therefore, more parts. Exhaust heat recovery requires very expensive regenerators. Variable nozzle turbines in parallel would improve the part load fuel consumption but would greatly increase production costs. Higher temperatures combined with regeneration and high compression ratios could result in a fuel consumption comparable to a diesel engine.

For this to be accomplished gas temperature would be about 3000°F. and would require regeneration. This, in turn, requires either new materials or a cooling system for the turbine wheels. Since cooling systems are impractical, cheap materials are absolutely essential if gas turbine powered automobiles and trucks are to appear in any numbers on our highways. The future of the jet automobile depends almost exclusively on the search for cheap, strong materials.

TRAIN *(Continued from page 11)*

arrangement permits the passengers to actually walk between the wheels and the resultant center of gravity is lowered to a point 2 feet lower than that of a standard coach. A standard passenger car is supported so as to clear the wheels under all curvature conditions. As a result, the center of gravity for this standard equipment is high, about 64″ above the rails which causes the car to lean outward on a curve like an automobile. Since the center of gravity of the Talgo car is about at the point of suspension of the running gear, this metronome or inverted pendulum effect is not possible.

The forward end of each coach unit has a folding pair of dolly wheels similar to those attached to the big trailers used on our highways to support and maneuver the units when uncoupled.

One may stop to ask, will roadbed design have to be modified for this new type of train? The answer is no. With the heavy standard equipment, trackage on curves is super-elevated to counteract the overturning action of the heavy cars. For high speed trains the super elevation is necessarily quite high. However, when a slow freight train travels over the same track, the pressure of the wheels on the inside rail of a high speed curve increases the drag on the locomotive as much as 15%. Accordingly, under normal conditions a compromise in the elevation is necessary resulting in speed restrictions for the faster train.

With Talgo, however, such a compromise is not necessary. Super elevation is still required for riding comfort but it can be reduced, thereby decreasing the detrimental effects on slower trains. Furthermore, the weight of a five unit Talgo coach is approximately one-fourth that of a standard coach and with the lower center of gravity the overturning moment is reduced. How did the inventor save so much weight?

The ACF Talgo design uses less material in construction, especially in the framing, and as a result the use of aluminum alloys has been extended far beyond many previous railroad installations. Furthermore, the machinery and accessories normally suspended beneath the cars have been installed in one of the units which contains a small kitchenette, air-conditioning equipment, and the passenger's toilets; also, water for the whole train is carried in the locomotive.

It may be noticed that ACF was just mentioned in explaining the reduction in weight. The American Car and Foundry Company was the contractor

Please turn to page 26

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Higher frequencies for transistors point to their use in television, radio, communications and more efficient electronic controls for airplanes and guided missiles. The small size, long life, and low power requirements of transistors suggest entirely new electronic devices—as well as use of transistors as working partners with electron tubes.

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shovel and climbing signal masts and bridges. I walked every foot of the New York Division from Jersey City to Elizabeth, New Jersey.

In November I went with the Bethlehem Shipbuilding Corporation, Bethlehem, Pa., as an electrical ship draftsman at $119.00, doing layouts on cruisers and tankers. In those days one man did all the electrical design for a tanker.

In January I moved to Philadelphia as an electrical designer at $35.00 per week with Stone and Webster on the Richmond Station. I almost went to Chile as a telephone engineer at $2,400 annually with the Braden Copper Company. Instead I went with B. F. Goodrich Rubber Company, Akron, as electrical designer at $2,700 in May 1920.

By this time Dean Howard Lincoln Hodgkins of the Engineering School was tired of writing recommendations and offered me a job as instructor in Electrical Engineering at $2,500. I reported September 1, 1920 and have been here ever since.

In December 1920, I received an appointment as Assistant Radio Engineer at $3,000 with the War Department and continued my teaching before 9 a.m. and after 5 p.m. at a reduced salary of $1,500. Those were "rough" days but I was single and had borrowed money to buy a diamond ring. I repaid the loan quickly and married the girl, Mary Olive Jennings of Grenada, Mississippi, June 9, 1921.

After working full time for the War Department and teaching 10 hours in Summer School of 1921 I returned to GWU as full time instructor in September. I moved up through the grades becoming full professor in 1929.

I was always curious as to what the lawyers had that engineers didn't have and entered the Law School in February 1925 to find out. By February 22, 1925 I had some idea and an LL.B. I strongly urge all engineers to study law. In June 1929 I fulfilled the requirements for the degree of Electrical Engineer and was the first to receive a professional degree under the present arrangements.

A sabbatical semester at MIT in 1932 and the following summer enabled me to complete the residence requirements for a Master's Degree.

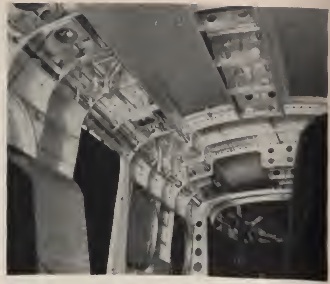
The years passed. World War II came. Just prior to its outbreak I served a year of extended active duty in Headquarters Army Air Corps from September 20, 1940 to September 19, 1941 and resumed my work at GWU. Then Pearl Harbor happened and I was back in uniform in December.

In April I was requested as Information and Education Officer, Army Air Forces in the Mediterranean Theater with headquarters in Caserta, Italy. The European war folded up soon after. I lacked points to come home and was ordered to Leghorn, Italy, as I&E officer for the Peninsular Base Section. When the Theater Headquarters in Caserta closed I became Theater I&E Officer, including supervision of "Stars and Stripes," "Yank" and American Expeditionary Stations, radio station network. This was the most fascinating job I'll ever have!

Please turn to page 28

and the designer (based on Goicoechea's original design) of the three Talgo trains now in existence. Two of these trains are three-coach trains built for use in Spain and 5′-6″ gauge track. The third train was built for experimental purposes here in the United States and is identical to the Spanish train with the exception of length and gauge. The American Talgo consists of a diesel-electrical locomotive, a baggage unit and a coach of five units, one of which is for equipment and one serves as an observation-lounge car.

It is now necessary to describe the coaches in a little more detail. The floor is only 18-inches above the rails. Each unit is 20 feet long and seats 16 persons; the observation unit is 27 feet long. The over-all height of these units is 4 feet lower than that of a standard coach. Of course, the most startling feature is that the coach units are mounted on two wheels. The frame work is aluminum alloy. A "U" shaped center sill 5½ inches deep forms the backbone of the unit. Crossbearers, floor beams and stringers are "X" sections. Side frames are continuous hydraulically pressed members extending from the side sills to the center line of the roof. Channel sections are used in bracing the side posts which are further braced



Talgo Structure

by the longitudinal eave, drip and belt members. Flat sheet aluminum is used for skin metal between eaves and belt and beaded aluminum used for the lower sides of the roof. The roof framing consists of the side frames and two purlins constructed from "J" sections. The beading of the roof metal acts as additional purlins adding to the rigidity.

A false floor of aluminum is riveted to the underside of the floor framework. The floor deck is of Plymetal. When partitions are used they are also Plymetal.

In general, the unit ends are open to form a continuous coach. Joints between cars are closed by rubber diaphragms with specially designed zippers with sealing lips. This assures a pressure proof closure and forms a dead air space for insulation.

Couplers are vertical and horizontal pin devices acting as the draft gear. Vertical loads are carried by load bearers with centers about 32-inches above the rails. Two safety cables at each coupling supports the train behind until the train can be halted in case the train is broken.

Brakes are automobile type, internal expanding, fastened to the wheels. Wheels are built-up welded construction with the tire separated from the wheel by a rubber sandwich.

Hydraulic braking with 250 lbs. pressure is provided from 100 lb. air pressure transferred to the hydraulic system.

On the head end of this speedster is a specially-built locomotive with an over-all height 2 feet less than that of a standard diesel. The reduced height results in smaller frontal silhouette which

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POWDER METALLURGY *(Continued from page 12)*

method of production lies in the fact that the properties of the finished product can be controlled by varying die pressure, "sintering" temperature, etc. This process is also quite rapid. Some machines can make up to 300 compacts per minute, while on some rotary multistation presses up to 1,000 compacts per minute can be made.

There are also some disadvantages or limitations in the use of this process. For instance, metal powders are expensive to make and difficult to store without deterioration.

The main limitation of this process is that only simple-shaped articles can be made. The reason for this is that metal powders do not flow well around corners. Thus parts with undercuts or flanges cannot be made because, first, the flange might not get filled with powder, and second, if it did the pressure applied to the powder in the flange would not be sufficient to give the required density or strength to that part of the article. For this same reason, it is impractical to use cores in the dies, unless the core is placed parallel to the direction in which the pressure is applied.

Another unsatisfactory characteristic caused by the poor flow of the metal powder is that of density variation within a given part. For example, if a cylinder were to be made by applying pressure at both ends, the density of the metal at the outside of the cylinder at its midpoint would be found to be a minimum for the cylinder. This would cause a weak point in the cylinder. Also the shrinkage which takes place during "sintering" would be uneven. It is a general rule that the ratio of length to diameter of the pressed part should not exceed 2.5 to 1.0.

These are but a few of the most important aspects of powder metallurgy, but it can be seen that this relatively new manufacturing process has its place in modern industry and provides better methods for producing a wide variety of articles.

AMES *(Continued from page 24)*

Returning to the USA in January 1946 I was separated from the service on January 31st and reported again at GWU February 1st just in time to get braced for the GI wave when enrollment in the E. E. Department passed 600, considerably more than we have in the Engineering School now.

My last venture away from the job was a sabbatical year at the Swiss Federal Institute of Technology in Zurich during 1951-52. I learned a lot and saw a lot more. The Swiss are smart, honest to a fault and hard working. Some day, if I complete a dissertation I may get some sort of doctor's degree. Right now, while trying to run the department with sixteen wonderful parttime instructors, this seems a little remote.

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Westinghouse Research Laboratories
Enrolled in Westinghouse Graduate Student Training Course after graduation from Purdue University in 1922. Dr. Hanna, with over 100 patents to his credit, is one of the nation's leading authorities on gyroscopically controlled regulating devices.

Carroll V. Roseberry, *Manager*
Westinghouse Electric Utility Department
Upon graduation from Oklahoma A & M in 1934, he enrolled in the Westinghouse Graduate Student Training Program. Assigned first as a salesman, he was advanced to district Assistant Electric Utility Manager, branch Electric Utility Supervisor, and in 1951 was appointed to his present post.

Dr. Edwin L. Harder
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TRAIN *(Continued from page 26)*

in turn results in a wind resistance drop of approximately 14%. This is important at speeds above 60 mph, because wind resistance above that speed increases in proportion to the square of the speed.

The power plant is composed of light-weight diesel engines of approximately 13½ pounds per h.p. which drive two extra-heavy-duty motors with each of two 405 h.p. input generators. This power plant permits the locomotive to operate with equal facility in high-speed level operation or in heavy grade mountain service. Four diesels (2 main engines for motive power and auxiliaries for 110v A.C. power) provides availability heretofore unattainable in a single locomotive. The train can be operated using one main engine and one auxiliary in the event of an emergency. The main propulsion engines are Hercules DNXV8S Diesels connected to the traction generators through a ventilated bell housing. The auxiliaries are Hercules DFXE Diesels direct-connected to the auxiliary alternators.

Train current is 50 cycle 208/110 volt, 3 phase, and is generated by two 168 h.p. 1500 rpm alternators.

Engines are removed from the locomotive by pit type elevators by dropping them between their supports.

The speed-tractive-effort performance has a wide range. The train can accelerate from 17 mph to 105 mph without exceeding the continuous rating of the traction motors.

Rubber-in-shear engine mountings practically eliminate vibrations in the structure. The power from diesel-alternator sets supply the train with electricity for both heating and air conditioning as well as lighting. As was mentioned before, the train line water system is taken from the tanks in the locomotive.

It is interesting to know that the power of this Talgo locomotive amounts to 25% at 100 pounds. The locomotive is a B-B diesel-electric of 1,150 h.p. driving four traction motors geared to a speed of 105 m.p.h. The train has tremendous pick-up as well as a high braking effect which results in a very fast timetable. Braking is done by clasp brakes on the locomotive with a 250% braking ratio.

The air-conditioning system weighs approximately 1,800 pounds and provides about 8 tons of refrigeration. Conditioned air is delivered to the coach units from Anemostats and returned through grills at the floor level. The air conditioning system is electronically controlled.

Collision protection is provided by the use of tubular members in the nose.

This train was on exhibition in 1949 at the Railroad Fair in Chicago where the author had the opportunity of giving it a thorough inspection. It is understood that the American Railroads are extremely interested in this type of train. However, ACF is still working and perfecting Talgo so that it will meet the high, exacting standards established by the American railroads. Until then no effort will be made to place this train in service on American rails.

All Illustrations Courtesy of American Car & Foundry Co.

Talgo Interior

"We always admire the other fellow more after we have tried to do his job."